Stoller
Hanford Office

DOE-EM/GJ703-2004

C4177
Log Data Report

Borehole Information:

Borehole: C4177			**Site:** 216-Z-7 Crib		
Coordinates (WA State Plane)		**GWL (ft)[1]:** Not Available		**GWL Date:**	Not Available
North	**East**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
Not Available	Not Available	07/02/04	N/A[3]	50	Push

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	0.4	6 5/8	5 1/2	9/16	0.4	50

Borehole Notes:

The logging engineer used a caliper to determine the outside casing diameter. The caliper, casing stickup, and inside casing diameter were measured using a steel tape. All measurements were rounded to the nearest 1/16 in. C. Cearlock (Fluor Hanford) provided the casing depth. All logging measurements are referenced to ground surface.

Logging Equipment Information:

Logging System:	Gamma 2A		**Type:** SGLS (35%) 34TP20893A
Calibration Date:	03/2004	**Calibration Reference:**	DOE-EM/GJ642-2004
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 1C		**Type:** HRLS planar 39A314
Calibration Date:	05/2004	**Calibration Reference:**	Not Available
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 4L		**Type:** Passive Neutron U1754
Calibration Date:	None	**Calibration Reference:**	None
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4 Repeat	
Date	07/12/04	07/12/04	07/12/04	07/12/04	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	49.0	18.0	15.0	13.0	
Finish Depth (ft)	18.0	15.0	0.0	8.0	
Count Time (sec)	200	20	200	200	

Log Run	1	2	3	4 Repeat	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	0.5	
ft/min	N/A	N/A	N/A	N/A	
Pre-Verification	BA364CAB	BA364CAB	BA364CAB	BA364CAB	
Start File	BA364000	BA364032	BA364036	BA364052	
Finish File	BA364031	BA364035	BA364051	BA364057	
Post-Verification	BA365CAA	BA365CAA	BA365CAA	BA365CAA	
Depth Return Error (in.)	N/A	N/A	0	0	
Comments	Fine-gain adjustment made after file -015.	No fine-gain adjustment. High rate interval.	Fine-gain adjustment made after file -036.	No fine-gain adjustment.	

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2 - Repeat			
Date	07/19/04	07/19/04			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	19.0	19.0			
Finish Depth (ft)	15.0	15.0			
Count Time (sec)	300	300			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	AC105CAB	AC105CAB			
Start File	AC106000	AC106005			
Finish File	AC106004	AC106009			
Post-Verification	AC106CAA	AC106CAA			
Depth Return Error (in.)	N/A	N/A			
Comments	No fine-gain adjustment.	No fine-gain adjustment.			

Passive Neutron (PN) Log Run Information:

Log Run	1	2 - Repeat			
Date	07/13/04	07/13/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	13.0			
Finish Depth (ft)	49.0	18.0			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
ft/min	1.0	1.0			
Pre-Verification	DL002CAB	DL002CAB			
Start File	DL002000	DL002193			
Finish File	DL002192	DL002213			
Post-Verification	DL002CAA	DL002CAA			
Depth Return	N/A	- 0.5			

Log Run	1	2 - Repeat			
Error (in.)					
Comments	No fine-gain adjustment.	No fine-gain adjustment.			

Logging Operation Notes:

Logging was performed with a centralizer installed on the sondes. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 082. Maximum log depth was 1.0 ft less than the reported casing depth. A high rate interval from 15 to 18 ft was logged with the SGLS at a 20 sec count time.

High rate logging was performed from 14 to 22 ft. The pre- and post-verification measurements were acquired in the CS-135 verifier, SN 1013.

Passive neutron logging was also performed in the borehole to detect neutrons that may be generated by interactions of alpha particles in the soil, or, to a less extent, from spontaneous fission. Pre- and post-verification measurements were acquired using an Am-Be neutron source.

Analysis Notes:

Analyst:	Henwood	Date:	08/02/04	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS and HRLS pre-run and post-run verification spectra were collected at the beginning and end of the day. All of the verification spectra were within the acceptance criteria. Examinations of spectra indicate that the detector functioned normally during logging, and the spectra are accepted.

Verification spectra using an AmBe neutron source were acquired for the passive neutron logging system. Currently there are no verification criteria established for this system. The counts obtained from the pre- and post- verifications were within 1 percent.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations for SGLS and HRLS spectra were calculated in EXCEL (source files: G2AMar04.xls and G1CMay04.xls, respectively). The passive neutron data require no data processing except to convert total counts to counts per second. The casing configuration was assumed as one string of 6-in. casing with a thickness of 9/16 in. to 51 ft (total logging depth). Dead time corrections are applied to the SGLS data where dead time exceeds 6 percent. Where SGLS dead time exceeds 40 percent, HRLS data are substituted. No water corrections were required.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot that also includes passive neutron measurements is included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs, ^{60}Co, and ^{154}Eu were the man-made radionuclides detected in this borehole. ^{137}Cs was detected between 1 and 3 ft with a maximum concentration of approximately 0.5 pCi/g at 3 ft. It was also detected between 13 ft and total depth (49 ft) with a maximum concentration of approximately 15,000 pCi/g at 17 ft.

^{60}Co was detected between 14 and total depth (49 ft) with a maximum concentration of approximately 28 pCi/g at 23 ft. It is likely ^{60}Co exists in the high gamma activity zone between 15 and 19 ft. The MDL for ^{60}Co is significantly increased in the high activity zone such that it may not be detected.

^{154}Eu was detected between 13 and 47 ft. The maximum concentration was measured at 60 pCi/g at 18 ft. It is likely ^{154}Eu exists in the high gamma activity zone between 15 and 19 ft. The MDL for ^{154}Eu is significantly increased in the high activity zone such that it may not be detected.

Passive neutron logging was performed in the borehole to detect neutrons that may be generated by interactions of alpha particles with oxygen and other less important elements in the soil or from spontaneous fission. Many transuranic radionuclides decay predominantly by alpha particle emission and the passive neutron system may be useful to identify the existence of transuranic radionculides where no gamma emissions are available for detection. The even number isotopes of plutonium such as ^{240}Pu also decay by spontaneous fission and are thus neutron emitters. There is no calibration for this logging system and the data provided are to be used qualitatively.

The passive neutron detector indicates the highest count rate (approximately 14 cps) at 15.75 ft, which approximately corresponds with the depth of the highest total gamma count rate (17 ft). The passive neutron may be detecting the decay of plutonium isotopes. The MDL for ^{239}Pu is greatly increased in the high activity zone and the isotope was not detected with the SGLS or HRLS. The approximate MDL for ^{239}Pu at 24 ft is estimated to be 63,000 pCi/g, based on the 375-keV gamma line. In the highest activity zone at 17 ft, the MDL for ^{239}Pu would be significantly higher. However, in the absence of significant ^{137}Cs and other interfering radionuclides, the MDL is approximately 20,000 pCi/g.

^{239}Pu was detected in borehole C4178, which is located approximately 120 ft southeast of this borehole. The maximum ^{239}Pu concentration measured in C4178 was approximately 240,000 pCi/g, which corresponds to a passive neutron count rate of 3 cps. On the basis of a greater neutron count rate (14 cps) in borehole C4177, it is possible plutonium isotopes exist at greater concentrations than those measured in C4178. However, **caution** should be used when considering this relationship since it is based on only two data points. Other factors such as the very high gamma flux may affect the counting characteristics of the neutron detector.

The ^{40}K and ^{232}Th logs showed an increase in concentrations at approximately 41 ft, perhaps suggesting a lithology change.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for the natural and man-made radionuclides. The passive neutron data are less repeatable but show enhanced count rates at similar depth locations.

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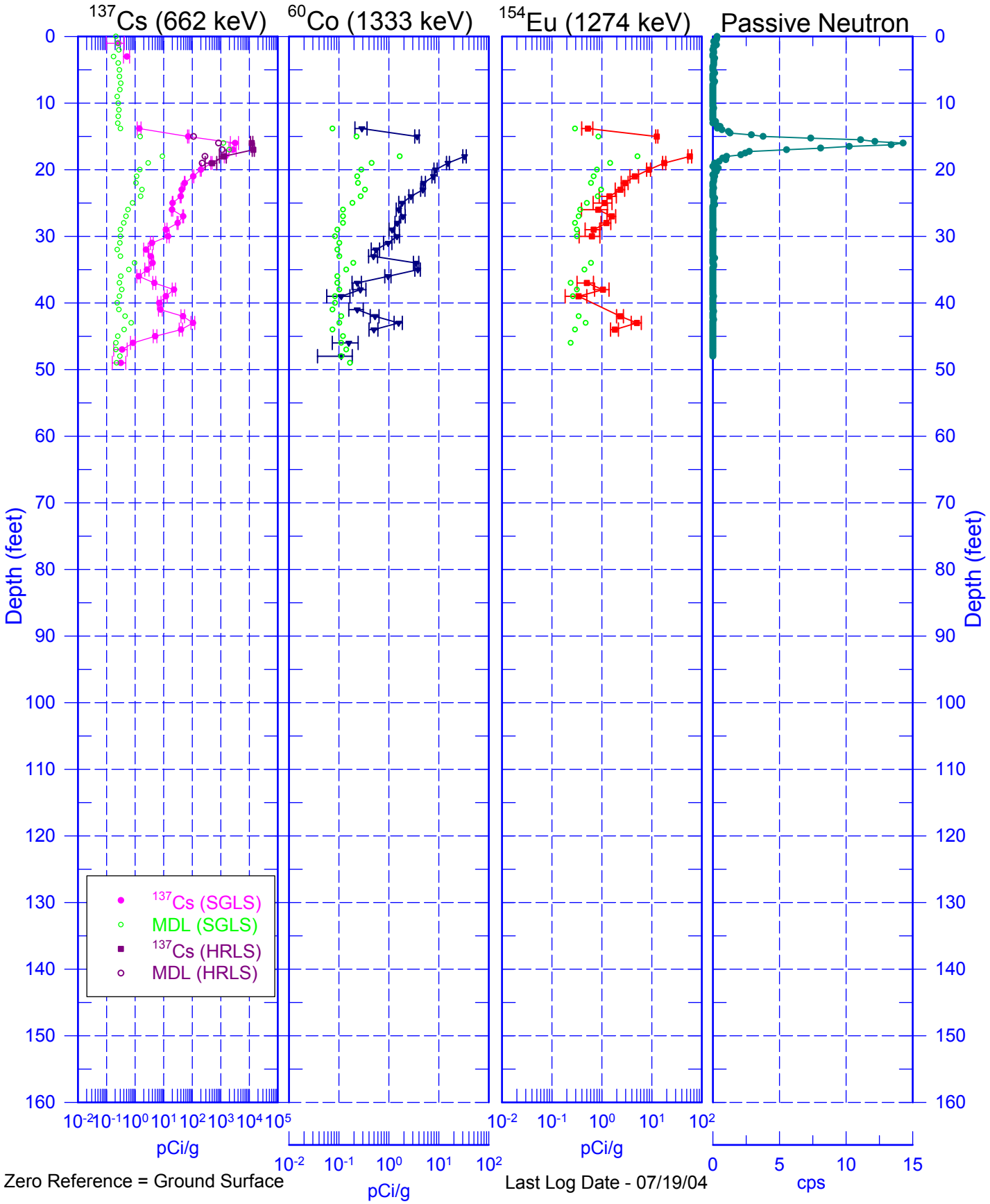
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not applicable

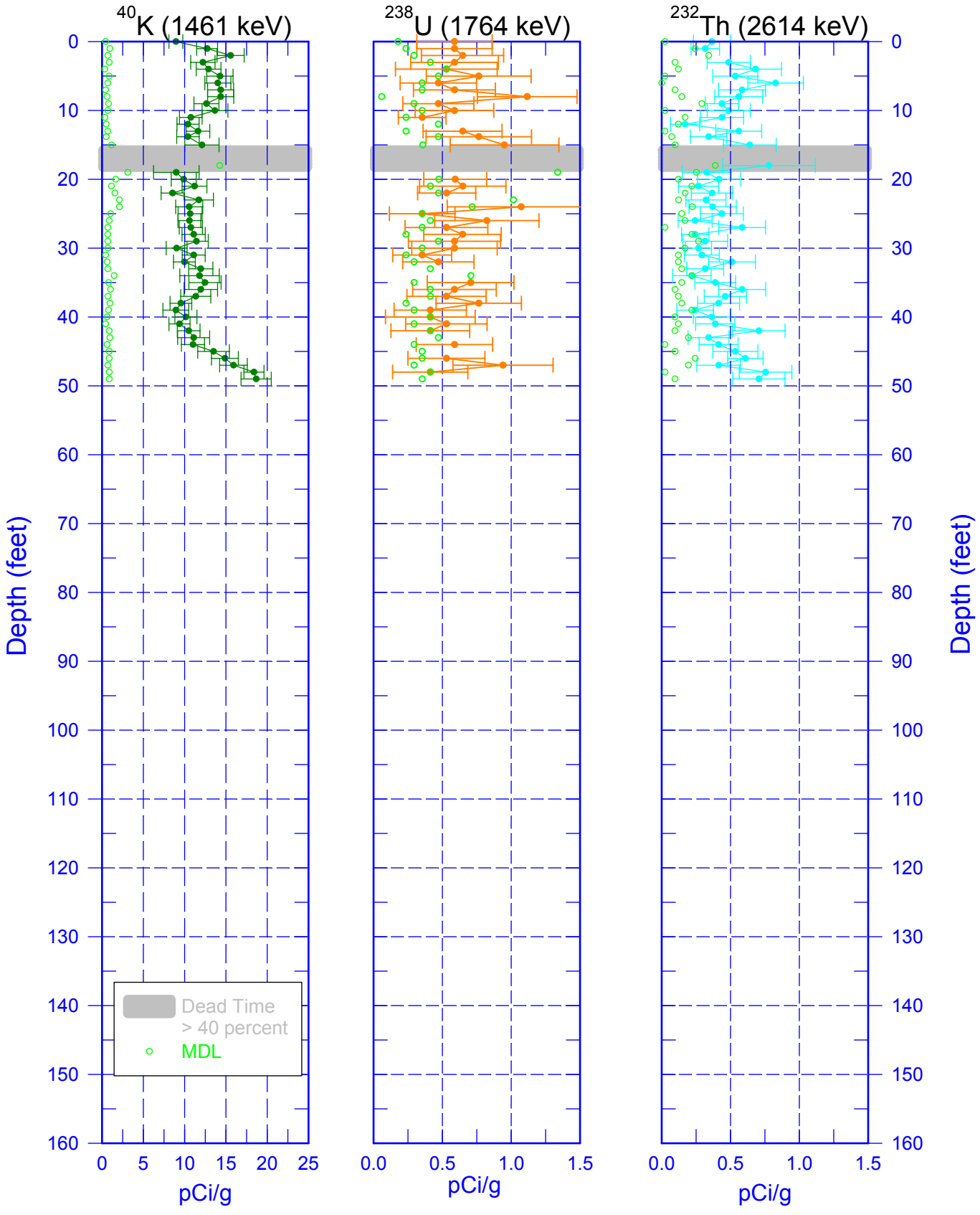
C4177
Man-Made Radionuclides



Zero Reference = Ground Surface

Last Log Date - 07/19/04

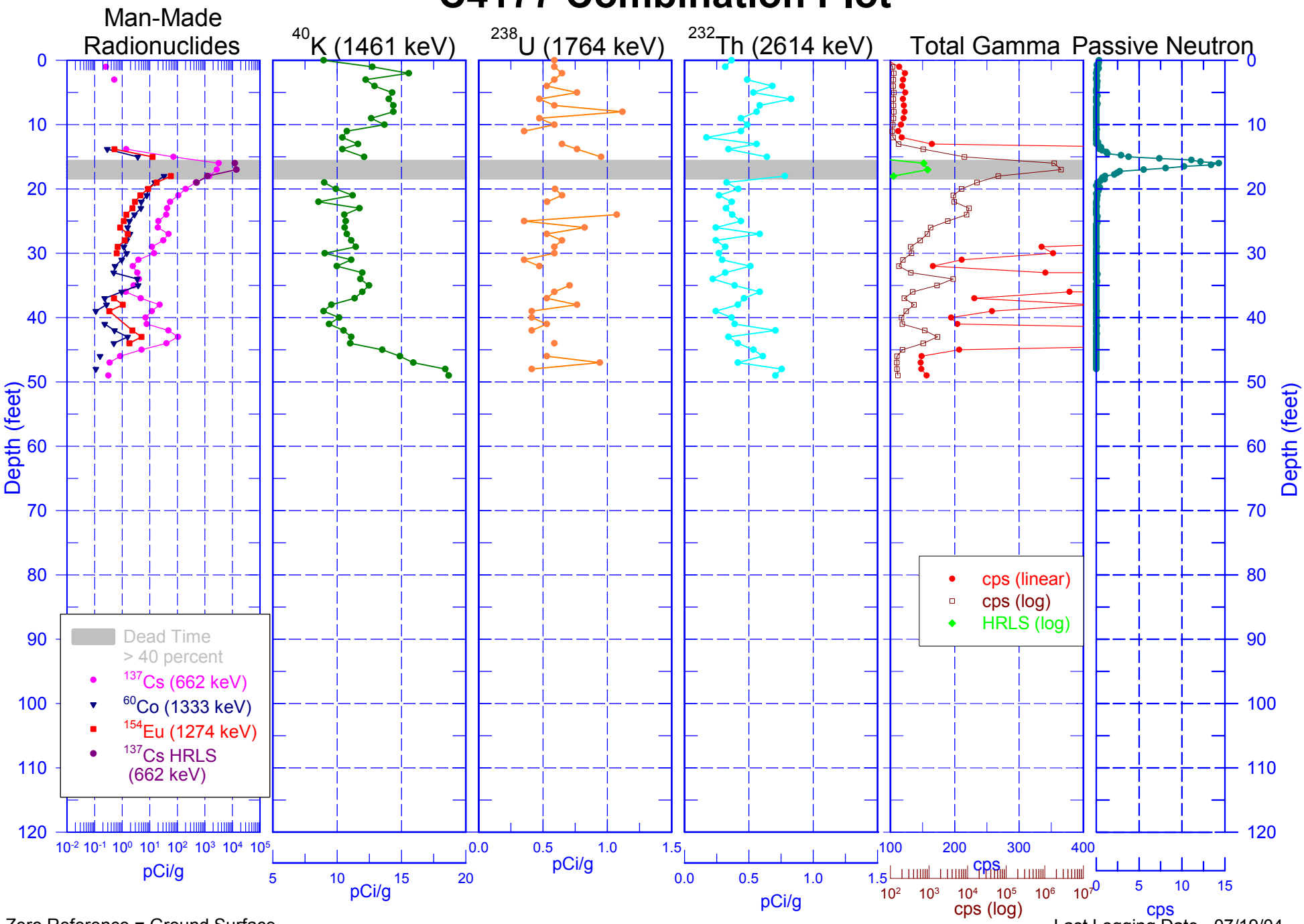
C4177
Natural Gamma Logs



Zero Reference = Ground Surface

Last Log Date - 07/19/04

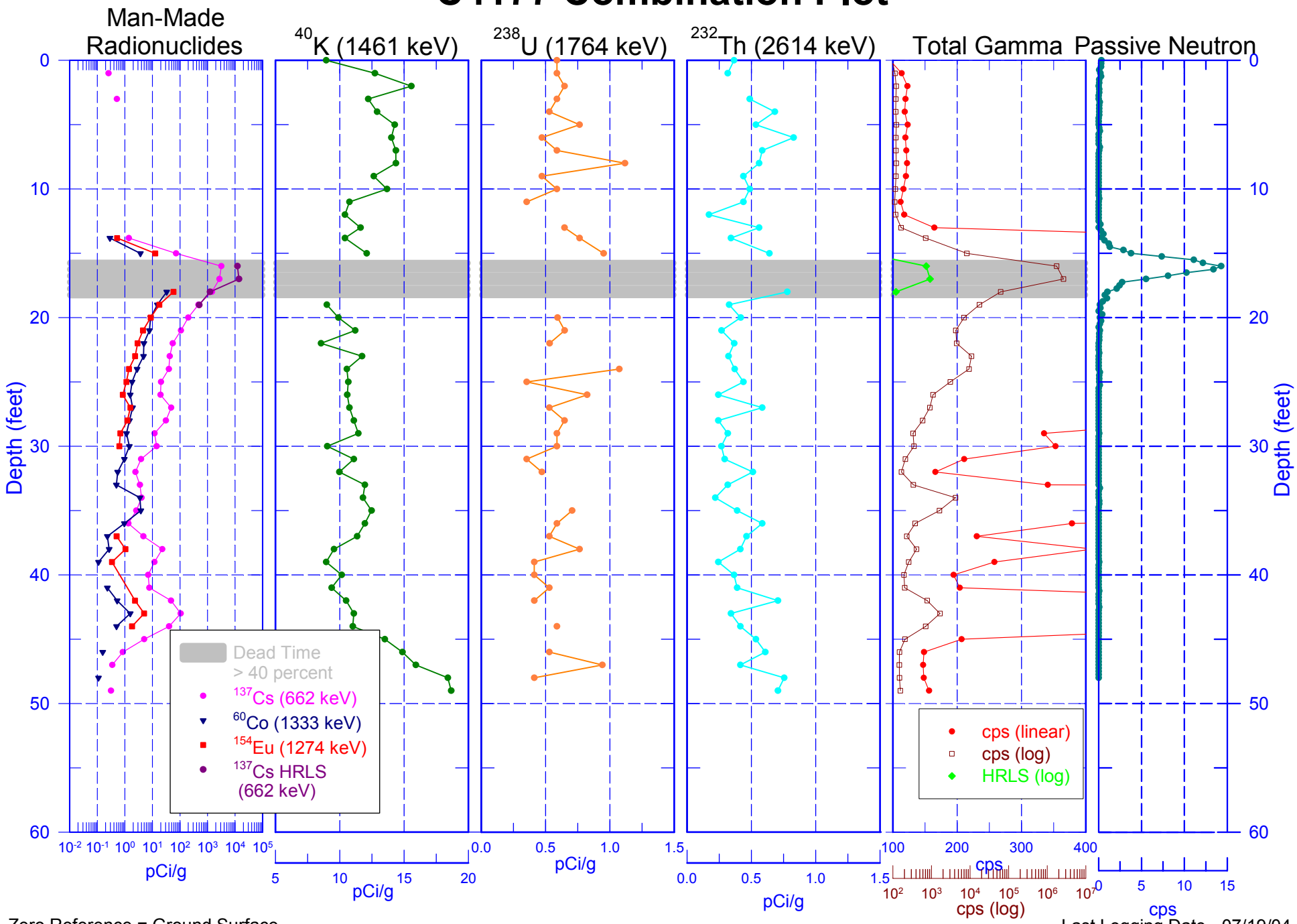
C4177 Combination Plot



Zero Reference = Ground Surface

Last Logging Date - 07/19/04

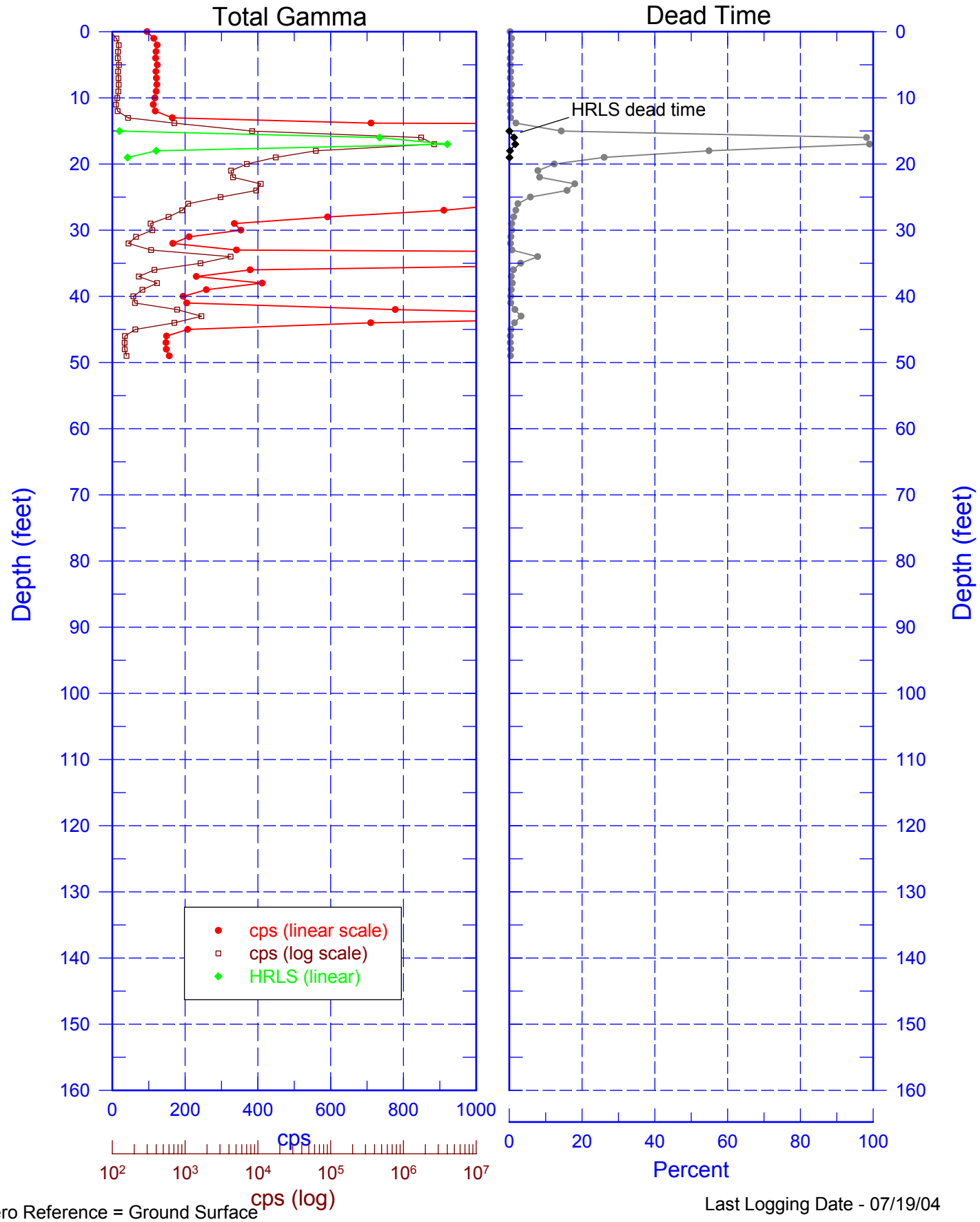
C4177 Combination Plot



Zero Reference = Ground Surface

Last Logging Date - 07/19/04

C4177
Total Gamma & Dead Time

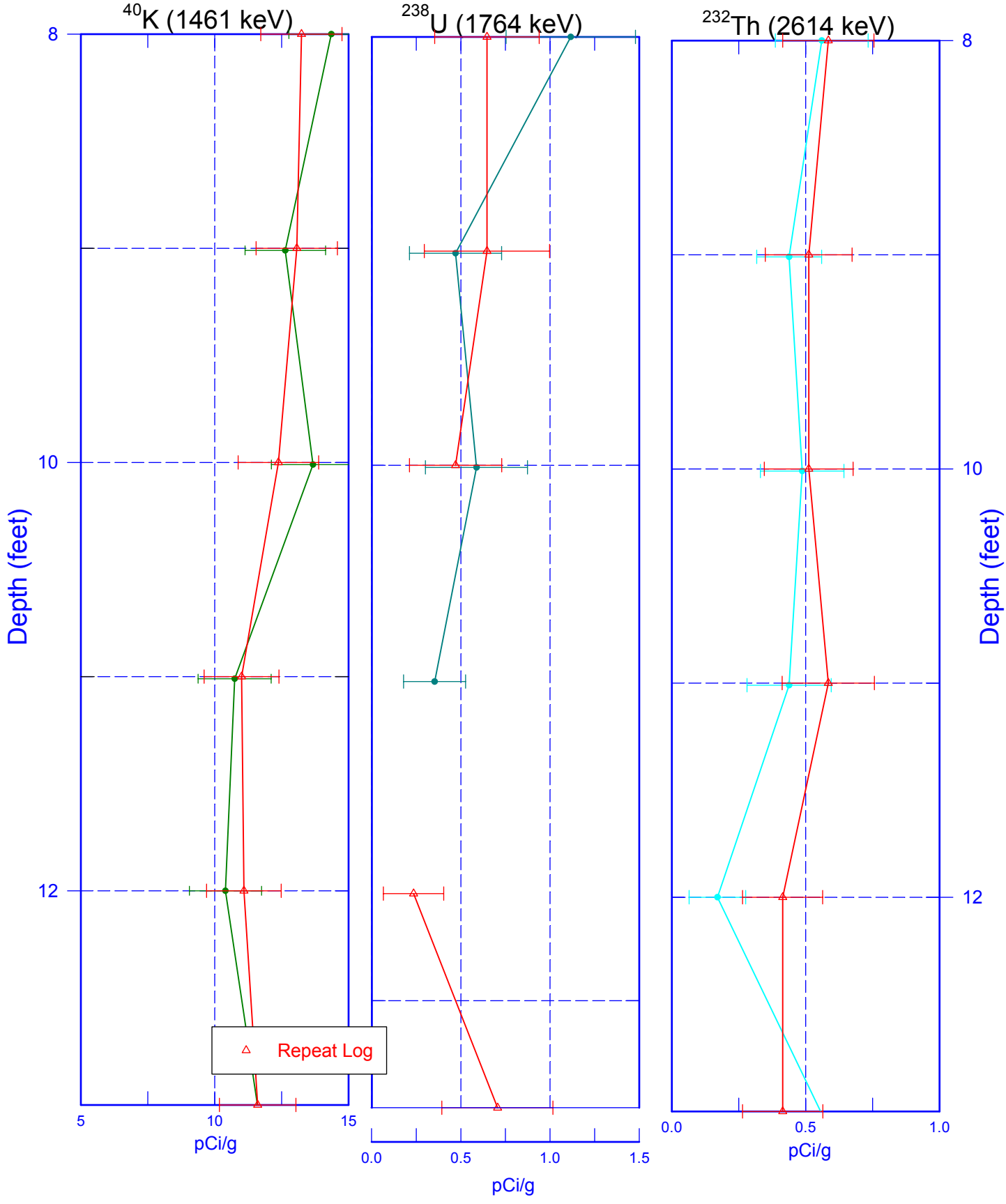


Zero Reference = Ground Surface

Last Logging Date - 07/19/04

C4177

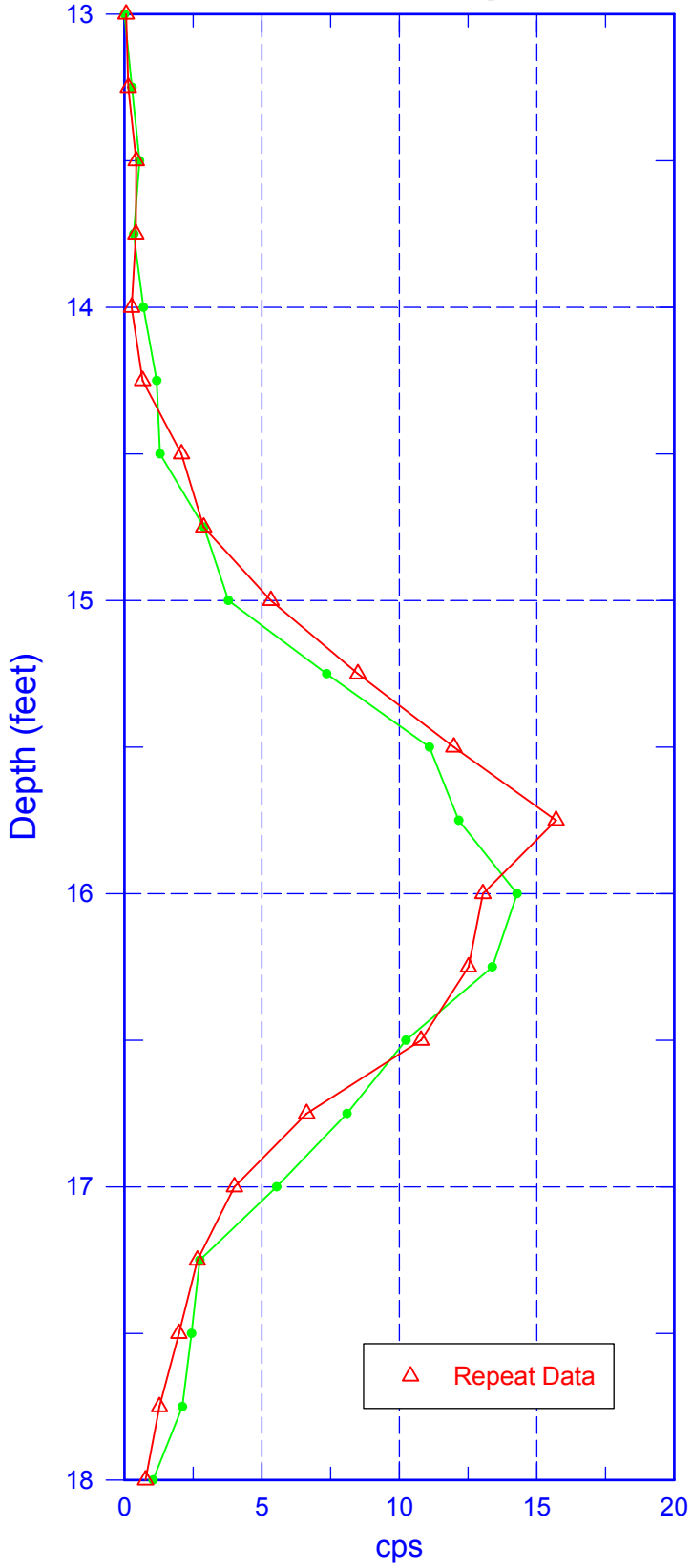
Repeat Section of Natural Gamma Logs



Zero Reference = Ground Surface

Last Log Date - 07/19/04

C4177
Passive Neutron Repeat Section



Zero Reference = Ground Surface

Last Log Date - 07/19/04